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APPLICATIONS OF ATOMIC ENERGY IN MEDICINE IN THE USSR

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The Soviet Union wages a consistent fight for disarmament, demands the complete outlawing of atomic and hydrogen weapons, and strives to see to it that the greatest discovery of human genius, i.e., atomic energy, will be used solely for peaceful purposes and for the benefit of the people.

In the USSR, atomic energy is increasingly being applied in various branches of popular economy and also in science and technology. Last year, the atomic electric power station of the Academy of Sciences USSR, which has a utilizable power output of 5,000 kw, was put in operation. Work is now being conducted on the creation of still greater power stations operating on the basis of atomic energy.

The development of nuclear physics has made possible the production of artificial radioactive elements in quantities which are, for all practical purposes, unlimited. At present, more than 700 different radioactive isotopes are being produced. In machine building, the building of ships, metallurgy, and other branches of the heavy industry, redioactive cobalt is used very extensively for the detection of faults (defectoscopy). The use of radioactive cobalt instead of the expensive radium or the cumbersome X-ray equipment makes it possible to introduce widely into industrial application a superior method of control.

Soviet public-health protection [services] use artificial radioactive substances, i.e., radioactive isotopes, for the therapy and diagnosis of various diseases. Until quite recently, only expensive natural radioactive substances, i.e., radium and mesathorium, were used in practical medicine. At present, the use of the artificial radioactive elements, particularly of radioactive cobalt, phosphorus, iodine, and sodium has been widely introduced. Because of their ready availability to the extensive network of therapeutic-prophylactic institutions, the artificial radioactive elements are by far preferable to natural radioactive elements.

Radioactive phosphorus is used in practical clinical work on an increasingly wider scale. Specifically, it is used for the therapy of some blood diseases, namely erythremia (an excessive quantity of red blood corpuscles) and leukoses. When introduced into the body, radioactive phosphorus accumulates in large quantities in the tissue of the bone marrow, where formation of the blood takes place. In this manner, the radioactive phosphorus selectively suppresses the pathological process occurring there.

Observations which have been conducted from 5 to 6 years in the scientific research institutions of the Academy of Medical Sciences USSR and at the clinics of Moscow, Leningrad, Kiev, and other cities make it possible to give a positive evaluation on the use of radioactive phosphorus in erythremia. The composition of the blood is improved; the general condition of the patients is affected favorably; and the capacity to do useful work is restored in the subjects treated.

Practical experience acquired at medical institutions indicates that radioactive phosphorus is less effective in chronic leukemia. Nevertheless, it is a good auxiliary agent when this disease is treated by means of X-rays.

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Radioactive phosphorus is used for the therapy of angiomas (vascular tumors) and of other skin diseases.

The armamentarium of Soviet medicine now also includes artificially produced radioactive iodine and radioactive sodium.

Radioactive iodine is successfully used in investigations of the activity of the thyroid gland, both in diseases of the gland itself and those of other systems and organs, defects in which may bring about faulty functioning of the thyroid gland. After being introduced into the body, the radioactive iodine accumulates predominantly in the cells of the thyroid gland. When the functioning of the thyroid gland is at an excessively high level (as for instance in Basedow's disease), there is an increased absorption of radioactive iodine by the gland. If the gland functions on an inadequate level, the radioactive iodine is absorbed in very small quantities. Consequently, one may judge on the basis of the quantity of iodine resorbed by the thyroid gland how this gland functions.

Lately, radioactive iodine has been used not only for purposes of diagnosis, but also for the therapy of diseases of the thyroid gland. The action of the iodine in such cases is based on the capacity of the gland, whenever it functions at an excessive rate, to resorb a large quantity of radioactive iodine. The radiation emitted by the iodine then brings the thyroid gland back to normal. A number of clinics in the USSR use this method in daily practical work. Radioactive iodine can also be successfully used in the diagnosis of brain tumors. If the thyroid gland has been first saturated with ordinary (nonradioactive) iodine, the radioactive iodine, by-passing the thyroid gland, will be deposited in considerable quantities within the cells of the brain tumor. The size of the tumor can then be estimated by measuring the quantity of radioactive iodine accumulated in it.

Another isotope, radioactive sodium, is used for measuring the rate of blood circulation in persons who suffer from various cardiovascular diseases. The sodium isotope, in the form of a sodium-chloride solution containing the radioactive tracer, is injected intravenously. By means of a special counter, the time which passes between the moment of the introduction of the isotope into the blood and its arrival, together with the blood at the spot being investigated, is measured. This time characterizes the rate of blood circulation.

Artificial radioactive elements are widely used in the therapy of malignant tumors. Radioactive cobalt has proved to be the most suitable element for this purpose. At present, radioactive cobalt is used not only at the leading oncological scientific research institutions, but also at oncological dispensaries.

The ready availability of radioactive cobalt and some significant characteristics which this isotope possesses determine its role in the practical therapy of malignant tumors and make it a perfect substitute for radium. Similarly to radium, radioactive cobalt exerts a destructive effect on tumor tissues.

Powerful teleradium equipment, which contains radioactive cobalt in a quantity that is equivalent to 400 grams of radium have made it possible to treat malignant tumors which are located at a considerable depth in the body. For instance, radioactive cobalt is used for the therapy of cancer of the lungs. However, not all types of malignant tumors can be treated by this method. Medical science is faced with the task of continuing research which has a bearing on this method of treatment and of developing more perfect methods of subjecting malignant tumors in different organs of the human body to the action of radioactive substances.

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Favorable reports have been made on the therapeutic properties of radioactive cesium. This isotope is used successfully for the therapy of certain superficially located malignant tumors.

The treatment of a number of malignant tumors is being carried out by means of teleradium equipment, i.e., the so-called radium cannons. Depending on the depth of the location of the tumor, the distance between the source of radiation and the surface of the body of the patient is varied. Considerable use is made of the intratissue method of radiotherapy, which involves the use of radioactive needles introduced directly into the tissue of the tumor at a certain depth and at definite distances from each other. Medical science has also developed a method of treating tumors by introducing collodial solutions directly into these tumors. Radioactive phosphorus or radioactive gold is used for this purpose. The intratumor method of therapy is preferable to external irradiation, because with the use of this method, the destructive action of the radiation is limited to the confines of the tumor. The surrounding normal tissue remains uninjured.

At present, Soviet medical workers are conducting research which aims at preventing injuries to normal tissue when radiation therapy is applied. When external radiation is used, auxiliary methods are applied, such as the novocain block of the area being subjected to the action of radiant energy, the tying up of blood vessels which serve the area of the tumor, and treatment with various drugs.

Radioactive isotopes and compounds of a complex structure which contain tracer atoms are being used to an increasing extent in biological chemistry, physiology, microbiology, pharmacology, etc.

To give an example, use of the method of radioactive isotopes in biochemistry has enabled researchers to determine the exact details on the metabolism of complex substance containing tracer atoms. This type of research leaves far behind all previously used precise methods, including spectroscopic analysis. At present, large-scale research is being conducted on protein metabolism with the aid of amono acids containing tracer atoms. The problems of the synthesis of protein molecules in the body are being studied in this research.

In a number of cases, there are introduced into the blood of the human body for therapeutic purposes sera of hydrolysates obtained from casein or the blood of cattle, or other protein preparations are administered. The fate of the protein introduced into the body and the duration of its circulation in the bloodstream are of great practical importance. Many researchers have demonstrated with the aid of radioactive isotopes that the main quantity of the protein introduced intravenously into the blood stream disappears from the blood within 24 hours. This affirms the presence of active physiological mechanisms in the organism which keep the content of protein in the blood at a definite level.

The availability of radioactive isotopes has made it possible to study the metabolism of nucleic acids, which, as has been established, participate in the synthesis of protein molecules.

With the aid of radioactive isotopes, the metabolism of carbohydrates in the body is being investigated, particularly carbohydrate metabolism in diabetes. The date thus obtained effect a better understanding of the true nature of this disease and the mechanism of the action of the insulin used to treat it.

To study the metabolism of trace elements, i.e., cobalt, iron, iodine, bromine, and others, the radioactive isotopes of these elements are used as tracer atoms in experiments conducted on animals.

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In pharmacology, the mechanism of the action of various drugs and other substances is being studied with the aid of radioactive isotopes.

This short review of scientific research conducted with radioactive isotopes gives only a superficial idea of their application in Soviet medical work. Activities in this field are being constantly expanded, and in the near future it is assured that radioactive isotopes will be used in all fields of medicine.

On 1 April 1955, the collection of signatures to a document issued by the World Council of Peace and directed against the threat of atomic warfare will begin. There is no doubt that all inhabitants of the USSR will sign this document. The peoples who are vitally interested in a lasting and general peace will effect the outlawing of atomic weapons and the cessation of their production. The Soviet Union sets an example of the use of atomic energy for peaceful purposes. This powerful source of energy must and will serve peaceful purposes in such a manner that it contributes to the progress of humanity as a whole.

(Source gives an illustration accompanying this article and bearing the following caption: "At the Clinic of the First Moscow Medical Institute, Physician V. V. Selikhova Exposes a Patient to the Radiation Emitted by a 'radium Cannon' Charged With Radioactive Cobalt.")

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